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(56) Documents Cited  
GB 1593718 A EP 0083122 A2 US 3876145 A  
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(54) Abstract Title

Component mixing and dispensing nozzle

(57) An apparatus for dispensing material comprises a supply of a first material component, separate supply of a second material component, a mixing location wherein the first material component and the second material component are mixed, whereby the mixing of the first and second material components initiates a reaction therebetween, an outlet from the mixing location, through which the material exits, leading to a dispensing location, a pressurised fluid supply is introduced at the dispensing location, the contact of the pressurised fluid with the material producing the dispensed form of the material.

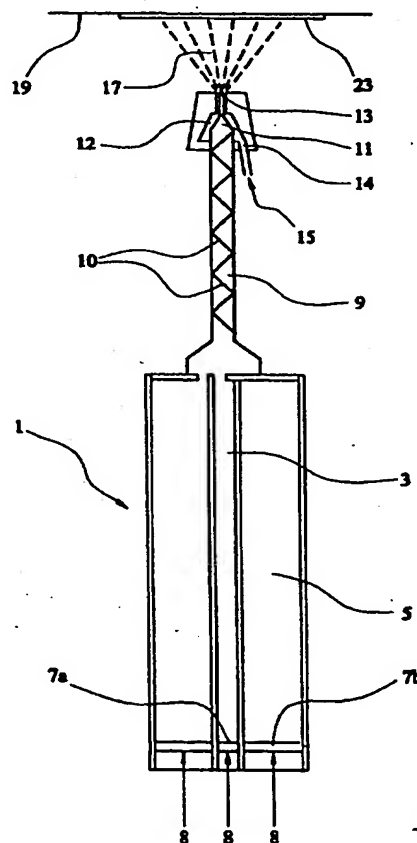


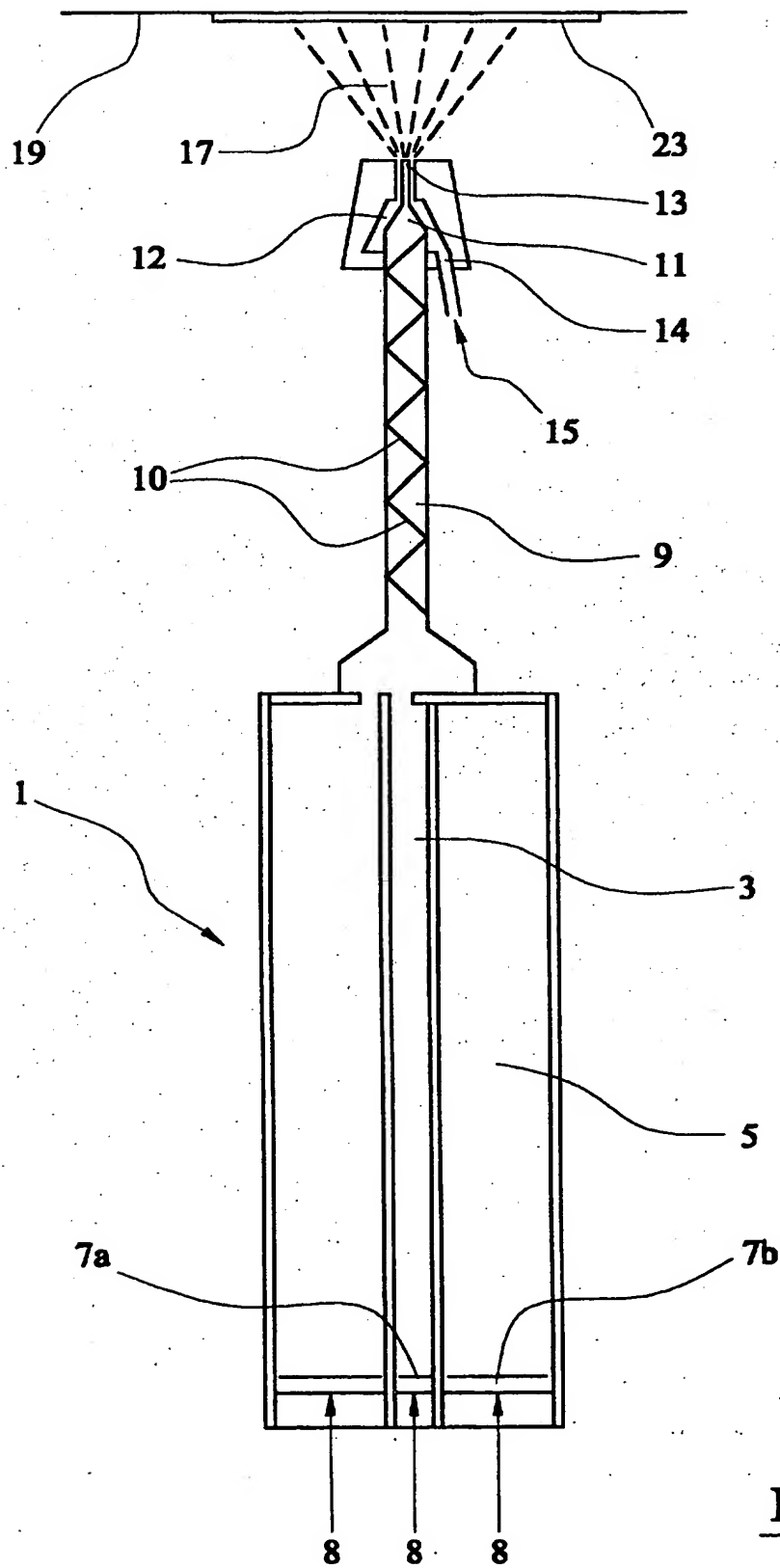
FIG. 1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print incorporates corrections made under Section 117(1) of the Patents Act 1977.

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**FIG. 1**

## IMPROVEMENTS IN AND RELATING TO THE APPLICATION OF MATERIALS

This invention concerns improvements in and relating to the application of materials, particularly, but not exclusively to the application of rapid curing materials. Such materials may include rapidly curing protective coatings, decorative coatings, mechanical coatings, chemical coatings and other types of special coatings. Such materials may be used to assist in the detection of marks and profiles, such as fingerprints and the like and/or removal of samples from locations.

Whereas slow curing liquid compounds with setting times (i.e. pot lives) of several hours, such as many two-part paints, can be pre-mixed and then sprayed using proprietary paint spraying machines. This process is impractical with multi-part polymers and other types of multi-part compounds which are formulated with rapid curing properties. Some multi-part polymers and compounds, once mixed, may have pot lives of minutes or even seconds, and normal application methods cannot be used as they are much too slow. The compound may well solidify in such cases before they can be applied.

In many instances, it is very desirable to be able to apply these extremely rapid curing multi-part liquid compounds to surfaces in thin films and in films of controlled thickness as in this way complete coverage of the surface can be assured in the quickest possible time, thus reducing process times and increasing efficiency. Controlled thickness of film also presents advantages with respect to reducing the flow of the compound after application, i.e. slumping.

This invention concerns apparatus for continuously applying such rapid setting multi-part liquid compounds to surfaces in thin films and in films of controlled thickness

in a manner which overcomes the problems associated with the rapidity of the curing / setting process.

The applications for this invention include all situations where a rapid-curing liquid compound mix is produced from a number of liquid components and is required to be deposited on to a surface as a film or in bulk whilst it is still in a fluid state, and prior to exceeding its pot life. Such applications, for instance, include the production of rapidly curing protective coatings, decorative coatings, mechanical coatings, chemical coatings and other types of special coatings.

A particular application occurs in forensic investigations where it is desirable to be able to take representations of locations, marks and the like which are very detailed, yet adapted to subsequent examination or use. For instance, during many forensic investigations it is desirable to obtain a copy of a fingerprint, tool mark or other mark left at a scene. Generally, representations of marks are taken in such cases by plugging any cavities in the area to be considered and / or providing a dam around the area to be considered with the material then being poured into it from a container. The base material and curing agent for it are generally added together in this container by the operator and manually mixed and adjusted to give the correct level, prior to pouring from the open container.

In other instances, such as materials inspection, it is desirable to obtain an accurate representation of material flaws, cracks, fractures, microstructures, surface finish, surface geometry and dimensional information.

In all of these situations the copy needs to fully and accurately represent all of the details of the mark in a reliable manner.

In other situations, and many others, it is desirable to be able to effectively and completely remove material

from potentially difficult to access locations, without damaging that material or otherwise inhibiting future investigations of it.

For instance, in forensic investigations it is often desirable to remove a DNA containing sample for subsequent investigation. Other potential applications requiring material removal include explosive residue and firearm residue investigations.

For some applications it is known to apply materials to the location being investigated to take up its shape. The method of application generally involves actively spreading the material over the location, for instance by painting it on. Such techniques require a highly fluid material which as consequence takes a great deal of time before it sets to a sufficient degree to be removed successfully from the location, carrying the imprint and/or sample of material. In certain cases, particularly in the forensic field, this manner of application can also damage or even destroy the imprint or sample under investigation.

The invention aims to provide apparatus more suited to the successful application of rapid curing materials in such situations, as well as methods using such apparatus and applications for such techniques. The apparatus of the invention is suited to solving this problem as it provides a suitable means for applying the compounds quickly enough to the surfaces in question in liquid form, but in a controlled manner.

According to a first aspect of the invention we provide apparatus for dispensing a material, the apparatus comprising

- a supply of a first material component
- a separate supply of a second material component,
- means for introducing a portion of the first material component into a mixing location

means for introducing a portion of the second material component into the mixing location,

mixing means being provided at the mixing location to mix the first material component and second material component to produce the material for dispensing, the mixing of the first and second material components initiating a reaction there between,

an outlet from the mixing location through which the material exits, the outlet leading to a dispensing location,

a pressurized fluid supply, the pressurized fluid supply being introduced to the dispensing location,

the contact of the pressurized fluid with the material producing the dispensed form of the material.

In this way, the invention may use static mixing equipment to simultaneously dispense two or more streams of material through a mixing nozzle to produce a fully mixed compound. The provision of a spray head, fed with a pressurized fluid, at the end of a mixing nozzle breaks the stream of mixed compound into droplets and propels them at the surface to be coated immediately after the mixing process is complete, but before curing / setting occurs. In this manner, a continuous stream of droplets of freshly mixed, rapidly curing compound with a significant remaining pot-life can be produced and sustained for any period of time desired.

The first and/or second materials may be provided as liquids. The first and/or second materials may be suspensions, for instance of solid in liquid.

The first and / or second material may be silicone compounds.

The dispensed form of the material may have a fluidity of less than 3000 poise and more preferably less than 1500 poise. Fluidity in the range 10 to 1500 poise is particularly preferred.

The dispensed form of the material may have a pot life at 20°C of greater than 10 seconds and more preferably 20 seconds or greater.

The curing time at 20°C for the dispensed form of the material may be greater than 90 seconds and more preferably greater than 2 minutes. Preferably the curing time at 20°C is less than 10 minutes.

Preferably the dispensed form of the material replicates, or at least provides a representation of, features of less than 1, more preferably less than 0.5 and ideally less than 0.2 microns, in terms of their depth, and/or width and/or length.

Preferably the cured material has a Shore A hardness of between 5 and 60 and more preferably between 30 and 40.

The first material may be a base material with the second material being a curing agent and / or catalyst. Other potential materials suitable for use in the invention include Silcoset 101 and curing agent and / or Silcoset 105 and curing agent supplied by Ambersil Limited, Wylds Road, Castlefield Industrial Estate, Bridgewater, Somerset, TA6 4DD, or Permlastic supplied by Cotterell & Co, 15-17 Charlotte Street, London, W1P 2AA. In these materials, the bulk base material is provided alongside a curing agent or catalyst which upon mixing in the desired proportion gives the desired degree of fluidity prior to curing and setting.

The first and / or second material component supply may be provided by a reservoir of the material component from which the material component is expelled. A reservoir may comprise a bore adapted to receive a plunger / piston, with advancement of the plunger / piston expelling the material component from the bore.

In a preferred embodiment the first and second material component reservoirs are provided coaxially to one another. The supply of the first material component and second material components from their respective reservoirs may be

controlled by a common activator, for instance a plunger in each reservoir, the two plungers being fixed to one another.

Preferably the amount of material expelled from the first supply and / or the amount of second material component expelled from the second supply is controlled by the cross-sectional area of the outlet from that supply. Preferably the relative proportions of first material component and second material component introduced to the mixing location are controlled by the ratio of the cross-sectional areas of the supplies and most preferably the ratio of the cross-sectional area of the outlets from those supplies to the mixing location. Preferably the first material component and second material component are kept completely separate from one another until contact within the mixing location.

The mixing location may be elongate, preferably extending away from the supply of the first material component and / or second material component. It is particularly preferred that the direction of travel of the first material component and / or second material component from their respective supplies is consistent with the direction of travel of the first material component and / or second material component through the mixing location.

The mixing location may be provided by a tapering or straight chamber, most preferably with the chamber tapering from the material components supply end of the chamber down towards the outlet from the mixing location. A chamber having a conically profiled exterior and/or interior at its end may be provided. The mixing location may be detachable relative to the supply of first material component and / or supply of second material component and / or pressurized fluid supply and / or dispensing location.

The mixing means may be provided by the interior and/or exterior profile of the chamber defined at the mixing



location and / or one or more components provided within the mixing location. It is particularly preferred that the one or more components include one or more spirals. One or more of the spirals may have a reverse direction compared with one or more of the other spirals. Preferably one or more, ideally all of the spirals are Archimedes spirals.

Preferably the mixing means cause the first material component to mix with the second material component within the mixing location so as to give a homogeneous mixture of the first material component and second material component. Preferably the combination of the first material component and second material component produces the material for dispensing, that material being a homogeneous material.

The first and second material components preferably undergo a reaction upon contact which produce the material for dispensing. The material for dispensing may undergo one or more changes with time following the mixing of the first and second material components. The change with time may be one or more of solvent evaporation, polymerization, coalescence or setting.

Preferably the dispensing material is capable of removal from the location to which it is applied as a coherent mass within five minutes of application to the location and / or dispense from the apparatus. More preferably the material is so adapted within three minutes and still more preferably within two minutes of contacting the location and / or dispensed from the apparatus.

Preferably the outlet from the mixing location has a cross-sectional area of less than 2mm, for instance 1.5mm to 0.5mm, and more preferably of less than 1.5mm. Preferably the dispensing location is defined within 1cm of the outlet, in the direction of travel of the material through that outlet.

The nozzle exit-hole diameter, fluid pressure and flow rate can be used to control the flow of the dispensed form

of the material and / or to control the droplet size of the dispensed form of the material.

Preferably the pressurized fluid supply is a pressurized gas supply, for instance compressed air. The pressurized fluid supply may be provided from a pressurized reservoir, such as a gas cylinder. The pressurized fluid supply may alternatively or additionally be provided by means for generating the pressurized fluid, such as a compressor.

Preferably the pressurized fluid supply flows into the apparatus through the dispensing location.

Preferably the pressurized fluid supply is introduced to the dispensing location perpendicular or parallel to the direction in which the material is introduced to the dispensing location.

The contact of the pressurized fluid with the material may produce a spray as the dispensed form of the material. The spray may be formed of a series of fine droplets of the material. The material may be in liquid or highly fluid form at this time.

Preferably the material is dispensed from the apparatus in the direction of introduction of the pressurized fluid supply to the dispensing location.

According to a second aspect of the invention we provide a method of obtaining information about one or more markings and / or residues on a surface, the method comprising applying a material to the surface as a spray, allowing the material to assume an integral form and removing the material from the surface in that integral form, the side of the material contacting the surface containing the information about the marking or residue.

The material may be applied to the surface by apparatus according to the first aspect of the invention.

Further details, options and possibilities for the second aspect of the invention and / or for which the

apparatus of the first aspect of the invention is used or applied are set out below.

The markings may be fingerprints, handprints, earprints or other marks or imprints, for instance may be a part of a human or animal body. The markings may be fabric marks or marks made by items of clothing or apparel. The markings may be foot marks, footwear marks or imprints. The markings may be a tyre mark, track imprint or other mark or imprint made by a vehicle. The markings may be a mark or imprint on an item, location or body made by a tool, weapon or other instrument. The residues may be left by firearms, discharged firearms, explosives, discharge of explosives or residues left by contact with and / or use of other chemicals. The residues may be a DNA containing sample, for instance a blood sample, bodily fluid sample, skin sample, hair sample or the like.

The surface may be a part of a location, a surface of an item or the like. It is particularly preferred that the surface be glass.

The information may be a representation of a marking. Alternatively or additionally the information may be a sample of a material present on the surface.

The material may be provided as detailed in the first aspect of the invention.

Optionally the material is applied to the surface as a liquid. Optionally the material is removed from the surface as a solid. Preferably the material coalesces between application to the surface and removal therefrom. Preferably the material polymerizes between application to the surface and removal therefrom.

Optionally the spray is formed by mixing the material with a fluid, such as a gas, under pressure, for instance compressed air. The fluid and material may be mixed in a nozzle prior to dispense. The fluid and material may be

mixed after dispense, for instance by directing a gas flow into the material flow.

The integral form for the material may arise through one or more of drying, evaporation of a solvent, coalescence or polymerization. The integral form may be a layer, for instance a layer of less than 10mm thickness, or preferably 5mm thickness or even less.

The marking information may be provided by the removed material as a contrast mark and / or as a relief mark. A casting of the marking may in effect be taken.

The information on the residue may be represented in the material removed from the surface by the residue being retained on the surface of the material and / or embedded within the material. The residue may be removed from the material for further consideration and / or investigation.

Various embodiments of the invention will now be described, by way of example only, and with reference to the accompanying drawing, in which :-

Figure 1 illustrates a cross-sectional side view of an embodiment of an apparatus suitable for use in the present invention.

The present invention is described below in relation to forensic applications, for which this specific embodiment of the apparatus and applied material were developed and refined. It should be noted, however, that the system developed is suited to the application of the materials to other locations, such as fatigue cracks in metals, or to pick up particulate material present on a surface for subsequent consideration. Furthermore, by virtue of the advantages the system has been demonstrated to possess it is suited to use in the dispensing of other fast setting or drying materials in other situations, such as rapidly curing protective coatings, rapidly curing decorative coatings,

rapidly curing mechanical coatings, rapidly curing chemical coatings and other types of special coatings.

It should also be borne in mind that the scale of the dispensing apparatus will vary depending upon its desired function. Thus the forensic system described below is intended to be hand held and relatively small, but far more substantial apparatus, with larger gas supplies and / or larger cartridges, which may be pneumatically operated, which supply the feed materials, may be used for application of the dispensed material to large areas.

In many forensic cases, fingerprints, footprints or other informative markings are left at locations under forensic investigation. These can provide a way of confirming the presence of a person at a scene or their having had contact with an item. An integral part of this forensic investigation is the visualisation of the markings, their recordal for subsequent use (for instance, in further investigation or comparison) and permanent storage for future use (for instance, in legal proceedings).

In other forensic cases, successful removal of material from a location is involved as an integral part of sample collection for further work. Such cases include removal of DNA containing samples, explosive residues, firearm residues and the like.

The present invention aims to achieve the necessary recordal of the image or removal of the residue in a more efficient and reliable manner. The technique applies to the location a material of sufficient fluidity to take on the form of the location, including all surface details. The material is then give time to set. When removed as a single piece of set material, the material accurately models the location in question and/or removes loose material of interest from the location.

The material in question may be provided in a variety of forms, but a binary material, which only takes on the

desired properties, fluidity followed by rapid setting, after mixing is particularly preferred.

A preferred material suitable for use in the invention can be obtained from V Rollins at Microset Products Limited, 261 Weddington Road, Nuneaton, Warwickshire, CV10 0HE, England as product code Microset 101RF. This material is a two part silicone compound with fluidity in the range 10-1500 poise, a pot life at 20°C of 20 seconds or above, a curing time at 20°C of 2 minutes or above, a surface replication resolution of typically 0.1micron, a hardness of 30-40 Shore A. The material is chemically inert and non-toxic.

To achieve the application of the material successfully the invention includes apparatus specifically designed to apply the material in question. The apparatus ensures the material is applied to the location whilst possessing sufficient fluidity to take up the profile, whilst successfully dispensing a material which very shortly thereafter sets to an extent allowing its removal from the location. This is achieved whilst avoiding undesirable premature setting of the material which could cause blockage of the apparatus. The nature of the apparatus also minimises the potential for material to set in the apparatus between its use on one occasion and subsequent use and/or facilitates the easy address of such problems.

As illustrated in Figure 1 the dispensing apparatus 1 comprises a reservoir 3 of a first material 4 and a reservoir 5 of a second material 6. Both materials 4, 6 are pushed from their reservoirs 3, 5 by plungers 7a, 7b on a common element 8 which operates in both bores. The common advance of the plungers 7a, 7b ensures that the correct ratio of the respective materials 4, 6 enter the mixing nozzle 9 by virtue of the different diameters of the two reservoirs 3, 5. The pressure generated in the materials 4,

6 is sufficient to advance the materials 4, 6 into and through the mixing nozzle 9.

Once in the mixing nozzle 9 the two materials 4, 6 are forced along helical paths which promote their thorough mixing. The mixing is controlled by the shape of the reversed spiral elements and fixed spiral elements 10. This mixing activates the nature of the binary materials and means that the combined material 11 at the exit end of the mixing nozzle 9 is in a form ready for use.

The material 11 leaving the mixing nozzle 9 passes to dispensing chamber 12 through narrow outlet 13. The outlet 13 brings the material 11 directly in to the air stream entering the chamber 12 through inlet 14 which is connected to a compressed air supply 15. The intimate contact of the air stream with the material 11 results in the material 11 being broken up into droplets and dispensed as a fine spray 17. The spray 17 can be directed at a target 19 as required. The targeting of the spray 17 can be controlled by moving the apparatus.

The target 19 illustrated is a sheet of glass believed to have fingerprints of interest on it.

Sufficient material 11 is sprayed onto the target 19 to form a continuous layer 23 over the area of interest. The material 11 is then left for a couple of minutes to coalesce and polymerize. Once set the layer 23 can be peeled off the target 19 to give a highly visible and permanent record of the fingerprints in the area sprayed.

The permanent record can be inspected subsequently in analysis, for instance comparison with other prints, and/or be presented as a record of the evidence in legal proceedings.

As the materials 4, 6 only mix in the nozzle 9 and as they only become active close to the dispensing end of that nozzle 9 the combined material 11 can be configured to give rapid setting once dispensed. Rapid setting enables the

marks or materials to be taken quickly. However, the rapid dispense of the material 11 once mixed ensures that it is sufficiently fluid to fully take up the shape of the location and/or mark and/or residue to which it is applied prior to setting. This is also achieved using a spray which avoids the need for force to be actively applied to the material once it is on the location, such forces could damage the fingerprint prior to its recordal, for instance. Rapid dispense also ensures there is minimal blocking of the nozzle 9 in use and minimising the volume of active material retained in the nozzle 9 also reduces the risk of setting in the apparatus between uses. If the material should set in the nozzle 9 and/or if it is desired to change the nozzle for other reasons, the nozzle 9 is provided as a detachable component relative to the remainder of the apparatus.

As well as offering a useful technique for obtaining fingerprints the technique is potentially applicable to situations where the material sets around other material of interest and is then used to lift the other material from the location. Such situations would include DNA containing samples, for instance, which are present in locations too difficult to access using other means or for which the sample volume is very small and highly efficient recovery is required.



CLAIMS:

1. Apparatus for dispensing a material, the apparatus comprising
  - a supply of a first material component
  - a separate supply of a second material component,
  - means for introducing a portion of the first material component into a mixing location,
  - means for introducing a portion of the second material component into the mixing location,
  - mixing means being provided at the mixing location to mix the first material component and second material component to produce the material for dispensing, the mixing of the first and second material components initiating a reaction there between,
  - an outlet from the mixing location through which the material exits, the outlet leading to a dispensing location,
  - a pressurized fluid supply, the pressurized fluid supply being introduced to the dispensing location,
  - the contact of the pressurized fluid with the material producing the dispensed form of the material.
2. Apparatus according to Claim 1 in which the first and/or second material component supply is provided by a reservoir of the material component from which the material component is expelled.
3. Apparatus according to Claim 2 in which the first and second material component reservoirs are provided coaxially to one another.
4. Apparatus according to Claim 2 or Claim 3 in which the supply of the first material component and second material components from their respective reservoirs is controlled by a common activator.
5. Apparatus according to any preceding claim in which the mixing location is provided by a chamber tapering

from the material components supply end of the chamber down towards the outlet from the mixing location.

6. Apparatus according to any preceding claim in which the mixing means are provide by the interior profile of the chamber defined at the mixing location.

7. Apparatus according to any preceding claim in which one or more components are provided within the mixing location to provide the mixing means, the one or more components include one or more spirals.

8. Apparatus according to any preceding claim in which the pressurized fluid supply is a pressurized gas supply, for instance compressed air.

9. Apparatus according to any preceding claim in which the pressurized fluid supply flows into the apparatus through the dispensing location, the pressurized fluid supply being introduced to the dispensing location substantially parallel to the direction in which the material is introduced to the dispensing location.

10. A method of obtaining information about one or more markings and/or residues on a surface, the method comprising applying a material to the surface as a spray, allowing the material to assume an integral form and removing the material from the surface in that integral form, the side of the material contacting the surface containing the information about the marking or residue.

11. A method according to Claim 10 in which the material is applied to the surface by apparatus according to any of claim 1 to 9.

12. A method according to Claim 10 or Claim 11 in which the markings are fingerprints, handprints, earprints or other marks or imprints made by a part of a human or animal body; fabric marks or marks made by items of clothing or apparel; foot marks, footwear marks or imprints; tyre mark, track imprint or other mark or imprint made by a vehicle; a mark or imprint on an item, location or body made by a tool,

weapon or other instrument; the residues are left by firearms, discharged firearms, explosives; discharge or explosives or residues left by contact with and/or use of other chemicals; a DNA containing sample, for instance a blood sample, bodily fluid sample, skin sample, hair sample or the like.

13. A method according to any of Claims 10 to 12 in which the material is applied to the surface as a liquid and the material is removed from the surface as a solid.

14. A method according to any of Claims 10 to 13 in which the dispensed form of the material has a fluidity of less than 3000 poise.

15. A method according to any of claims 10 to 14 in which the first and second material components undergo a reaction upon contact which produce the material for dispensing.

16. A method according to any of claims 10 to 15 in which the contact of the pressurized fluid with the material produces a spray as the dispensed form of the material.



INVESTOR IN PEOPLE

Application No: GB 0012276.2  
Claims searched: 1-9

18

Examiner: Jason Scott  
Date of search: 27 October 2000

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): B2F (FD, FKJ)

Int Cl (Ed.7): B05B (7/04)

Other: Online search strategy on file.

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 1593718 A K & C MOULDINGS See whole document and in particular	
A	EP 083122 A2 PROCTER & GAMBLE See whole document and in particular page 11, lines 4-19	
X	US 3876145 GUSMER See whole document and in particular column 1, lines 7-9 & column 2, lines 30-46	1, 2 & 8
X	US 3786990 GRACO See whole document and in particular column 2, line 36 to column 3, line 16	1, 2, 5 & 8

X Document indicating lack of novelty or inventive step  
Y Document indicating lack of inventive step if combined  
with one or more other documents of same category.  
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E Patent document published on or after, but with priority date earlier  
than, the filing date of this application.